Crankshaft

INTRODUCTION

The 4.0L engine uses a cast nodular iron crankshaft that rotates within seven **(7)** main bearings and has a standard bore and stroke of 98.4 x 87.4 mm (3.88 x 3.44”). Crankshaft rotation is clockwise, when viewed from the front of the engine.

The crankshaft is a cross-shaped four throw design with eight counterweights for balancing purposes. The crankshaft is supported by seven select main bearings with No. 3 serving as the thrust washer location. The main journals of the crankshaft are cross drilled to improve rod bearing lubrication. The select fit main bearing markings are located on the crankshaft counter weights. The crankshaft rear oil seal is a two piece design. The front oil seal is one piece design retained in the timing chain cover.

The crankshaft has a main bearing journal diameter of 63.489-63.502 mm (2.4996-2.5001"), and main bearing journal widths of (No. 1) 27.58-27.89 mm (1.086-1.098"), (No. 3) 32.28-32.33 mm (1.271-1.273"), and (Nos. 2, 4, 5, 6 and 7) 30.02-30.18 mm (1.182-1.188”).

The crankshaft has a connecting rod journal diameter of 53.17-53.23 mm (2.0934-2.0955”) and a connecting rod journal width of 27.18-27.33 mm (1.070-1.076”).

For high performance racing engines, Mopar Performance Parts recommends a forged crankshaft. Forged crankshafts allow you to specify to your grinder exactly what stroke you want, and cost less to have finished than billet crankshafts. And for those of you who want an oversize bore engine, a custom ground forged crankshaft **is** the way to go.

For more crankshaft specifications, refer to *4.0L Engine Specifications*, ‘Engine Assembly’ section of this chapter.

High Performance Crankshaft

This Mopar Performance Parts high performance crankshaft has a 3.41” stroke and has been carefully inspected and Magna-fluxed. 4.0L engine only.

P4529205	High performance crankshaft.

Balanced and Unbalanced Crankshafts

When describing crankshafts, we use words such as “balanced” and “unbalanced.” However, what **is** physically different about the crankshafts is not as obvious as the words may imply.

Since the unbalanced crankshaft is easier to understand, we’ll start with that one. Unbalanced crankshafts have SOLID journals. That means there are no holes through the first and last crankshaft journals. Racers like this because they can offset grind the crankshafts if desired. Other racers who use superchargers and/or alcohol fuel like solid journals because they see them as being stronger (because there are no holes in them). These are called “unbalanced” or “solid journal” crankshafts.

To spin-balance a typical crankshaft that has solid journals, you have to add Mallory metal. This can be expensive. Therefore, production crankshafts have a machined hole through the first and last journals. These are balance holes. Racers call them “balanced” crankshafts, so we call them balanced crankshafts. The name ONLY refers to the large 1-1/16” hole (approximately) through the first and last journal. The crankshaft should still be balanced with its specific connecting rods and pistons like any other race engine crankshaft. However, the big holes usually eliminate or cut down the use of Mallory metal.

Crank Bolt

The crank bolt is often used to turn the engine over by hand, but this is only a convenience item. Its real function is to hold the vibration damper on. That is why it is put on with so much torque. If the interference fit on the damper hub is not there and the crank bolt is not torqued, the damper can’t do its job. This will cause the crank to eventually fail.

To hold the damper on properly there is a special large, hard washer that is **used.** We have included this special washer in our damper attachment package (P4529677).

BASIC PREPARATION

When preparing **a** crankshaft for racing applications, the following steps should be performed:

1. Crankshaft bearing journals should be checked for specified diameter and clearance. If it is a hardened crankshaft, it shouldn’t be ground for clearance. These crankshafts are hard only to a depth of .0003". The main bearing clearances should be 0.03-0.06 mm (0.001-*0.0025”).*The best way to measure crankshaft journals is with a micrometer. To measure main bearing clearances, the bearings can be installed, the bolts torqued to specification, and the inside diameter of the bearing measured 90 degrees to the parting line with an inside micrometer or snap-gauge. The difference between these two measurements is the bearing clearance. Plastigauge is accurate enough for most race applications (P4286819–includes all 3 sizes).
2. The bearing journals may be polished by hand, first with #400 and then with #600 paper. Any nicks, burrs or scratches should be polished out. Chamfer oil holes in journals and use a wet stone to break edges. Check the oil passages to each journal.

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Caution: With the nodular cast iron crankshafts used it is important that the final paper or cloth polish after any journal regrind be in the same direction as normal rotation in the engine.

3. Crank alignment may be checked by installing the upper bearing shells in the block (at each end of the crank *only)* as well as the main caps (at each end of the crank *only).*

4. Before assembly, make sure crankshaft, including internal oil passages, is clean. Also be sure all oiling passages are drilled through!

5. When assembling the crankshaft into the block, oil the bearings and journals.

6. When installing the crankshaft, locate the main caps carefully so that the crankshaft spins freely, and torque all caps to specifications. Then spin the crankshaft by hand through several revolutions before installing the rear main seal. It should be fairly free, requiring very little effort. Remove the caps and check for any burrs. If present, they can be removed by gently scraping with a bearing knife. When installing the rear main seal, make sure it is properly seated; improper seating can cause the crankshaft to bind.

7. For better race engine oiling with a high capacity oil pump, 360" main bearing oiling is desired. 360° fully grooved main bearing sets should be used. It is NOT recommended that the crankshaft itself be grooved because grooves weaken the crankshaft.

8. **A** degreed damper is a must for racers since they must set their timing by total degrees advanced at a fairly high rpm (for example, 35° total at 2,500 rpm). A degreed damper is the easiest, most accurate, and most convenient tool for doing this. It also aids in setting the valve lash by giving 90° reference marks.

   Note: Damper degree timing tape is P4529070.

9. There are several additional items that should be checked during your build-up that will be helpful later:

   a. Measure the actual stroke of the crankshaft. We suggest that the extra time be invested and that two cylinders per crankshaft throw be measured. All measurements should be written in your engine building notes.

   b. Measure the deck height using a representative connecting rod and piston along with the actual crankshaft to be used. Be sure to oil the bearings in this step.

   c. Check the crankshaft end play.

   d. Check the connecting rod side clearance on each journal. Refer to 'Connecting Rods' section of this chapter for instructions. Always clean all parts used before proceeding to the next step.

10. Care must be exercised when tightening the bearing caps. When the cap bolts have been torqued to 80 ft-lbs, check to make sure that the oil pump can be inserted without binding on a main bolt hex head. If it binds, tighten the main cap bolt just enough more (no more than 1/6 turn) so the oil pump will clear the bolt with no binding.

SPECIAL CRANKSHAFT PROCEDURES

Measuring Main Bearing Clearances

There are two methods that can be used to measure crankshaft main bearing clearances: the Plastigauge method and the Direct Measurement method.

1. ***Plastigauge Method***

   When using Plastigauge (P4286819), check only one bearing clearance at a time.

   a. Install the grooved main bearings into the cylinder block and the non-grooved bearings into the bearing caps.

   b. Install the crankshaft into the upper bearings dry. Place a strip of Plastigauge across the full width of the crankshaft journal to be checked.

   c. Install the bearing cap and tighten the bolts to 108 N•m (80 ft-lbs) torque.

   DO NOT rotate the crankshaft. This will cause the Plastigauge to shift, resulting in an inaccurate reading. Plastigauge must not be permitted to crumble. If it is brittle, obtain fresh stock.

   d. Remove the bearing cap. Determine the amount of clearance by measuring the width of the compressed Plastigauge with the scale on the Plastigauge envelope (Figure 2-16). The correct clearance is 0.03 to 0.06 mm (.0010 to .0025") for all main bearing journals, with 0.051 mm (0.002") preferred.

   Plastigauge should indicate the same clearance across the entire width of the insert. If clearance varies, it may indicate a tapered journal or foreign material trapped behind the insert.

   e. If the specified clearance is indicated and there are no abnormal wear patterns, replacement of the bearing inserts is not necessary. Remove the Plastigauge from the crankshaft journal and bearing insert. Proceed to ***Main Bearing Installation,*** in this section.

   f. If the clearance exceeds specification, install a pair of 0.025 mm (0.001") undersize bearing inserts and measure the clearance as described in the previous steps.

The clearance indicated with the 0.025 mm (0.001") undersize insert pair installed will determine if this insert size or some other combination will provide the specified clearance.

Example: If the clearance was 0.0762 mm (0.003") originally, a pair of 0.0254 mm (0.001") undersize inserts would reduce the clearance by 0.0254 mm (0.001"). The clearance would then be 0.0508 mm (0.002") and within the specification. **A** 0.0508 mm (0.002") undersize bearing insert and a 0.0254 mm (0.001") undersize insert would reduce the original clearance an additional 0.0127 mm (0.0005") and the clearance would then be 0.0381 mm (0.0015").

Caution: Never use a pair of inserts that differ more than one bearing size as a pair. For example, DO NOT use a standard size upper insert and a 0.051 mm (0.002") undersize lower insert.

If the clearance exceeds the specifications using a pair of 0.051 mm (0.002") undersize bearing inserts, measure the crankshaft journal diameter with a micrometer. If the journal diameter is correct, the crankshaft bore in the cylinder block may be misaligned, which requires cylinder block replacement or machining to true bore.

If the diameters for journals 1 through 6 are less than 63.4517 mm (2.4981"), or journal 7 is less than 63.4365 mm (2.4975"), replace the crankshaft or grind it down to accept the appropriate undersize bearing inserts.

Once the proper clearances have been obtained, remove the crankshaft and proceed to ***Main Bearing Installation,*** in this section.

Plastigauge

When reassembling your engine you'll need a variety of Plastigauge to measure bearing clearances. This popular assortment includes one blue strip for .004" - .009" tolerances, two red strips for .002" - .006" tolerances, and two green strips for .001" - .003" tolerances. Each strip is 12" long.

P4286819	Plastigauge assortment.

2. ***Direct Measurement Method***

   The most accurate way of measuring crankshaft main bearing clearances is directly.

   a. Clean the main bearing journal of oil.

   b. Determine the maximum diameter of the journal with a micrometer. Measure at two locations 90° apart at each end of the journal.

   c. Compare the measured diameter with the journal diameter specification listed in the ***Main Bearing Fitting Chart*** (Figure 4-9), and select inserts required to obtain the specified bearing-to-journal clearance.

Top Dead Center (TDC)

One of the most important basics in engine building is being able to find Top Dead Center (TDC). To do this, you need a dial indicator and a bridge, which is a U-shaped bracket that will hold the dial indicator perpendicular to the piston top. The indicator should be placed over the flat part of the piston.

1. ***Finding*** TDC

   a. Place the dial indicator (minimum 1/4" travel) on top of the piston and rotate the piston to its maximum upward travel. This is TDC. On some engines this may be done without removing the head by inserting the indicator through the spark plug hole. Be sure the indicator is rigidly mounted.

   b. Affix a 360" protractor (or degree wheel P4452990) on the crankshaft with a pointer. Place the pointer as close to "0" (TDC) as you can by watching the indicator.

   Note: The Mopar Performance Parts 0-180-0 degree wheel is easy to read because 100+ degrees read directly.

   c. Rotate the crankshaft (clockwise when facing the front of the engine) until the dial indicator reads exactly .030" before TDC. Stop. Take reading from the degree wheel. Write it down. Reverse rotation (counterclockwise) until the piston comes up again and the dial indicator reads .030" exactly. Stop. Take reading from the degree wheel. This reading should be the same number of degrees from "0" (TDC) as the first reading, only on the other side of "0". If it is not, move the pointer half the difference in degree readings in the direction of the minimum degree reading.

   Note 1: The .030" selected was for explanation purposes only. Any measurement of .015" or greater is acceptable.

   Note 2: The reason for reversing direction to obtain the second degree reading is to take out any clearance in the connecting rod bearing and pin.

Example: With the degree wheel, pointer, and dial indicator in position, rotate the crankshaft (clockwise) until .025" is read on the indicator. (If you go past, just start again. DO NOT back up – go all the way around.) The degree wheel reads 8". Reverse rotation (counterclockwise) until the indicator reads .025" again. The degree wheel reads 350" (or 10" depending on the degree wheel). Move the pointer on the degree wheel 1" to read 351". Repeat the procedure. At .025" the degree wheel should now read 9" and **351".** Now the pointer is reading 0" at TDC exactly.

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TDC Indicator Tool

This is a handy, positive-stop tool for determining exact top dead center (TDC) when centerlining camshafts. This tool, made of hardened steel, is extremely accurate and can be used on all DaimlerChrysler six cylinder engines. It takes the guesswork out of finding TDC.

P4349737	TDC indicator tool.

Degree Wheel

Durable Mopar Performance Parts aluminum plate 0°-180°-0° degree wheel for centerlining camshafts. Features step-by-step installation instructions printed on back side.

P4452990	Degree wheel.

2. *Timing Mark*

Note: This procedure requires the timing chain case cover be bolted to the partially-assembled short block.

The timing mark is composed of two lines or marks, one on the crankshaft damper and the other on a tab on the timing chain cover, that indicate TDC. Once you have located TDC with the dial indicator, this true position should be checked against the indicated timing mark. Any deviation from the true TDC mark should be noted and the correction made permanently on the crankshaft damper. The new mark should be very visible. An error in basic timing of only *2”* can be very costly in terms of performance and/or engine damage. A *2”* error in timing can result in a pre-ignition failure or light to heavy compression ring scuffing which results in increased blow-by and lower horsepower output.

Mallory Metal

Mallory metal is typically used in race engines to balance crankshafts (refer to Figure 4-5). Many machine shops don’t like to use it because it makes the balancing process somewhat more complicated. However, as a racer, it’s important to know what Mallory metal is and what it’s used for.

Mallory metal is heavier than lead, which makes it much heavier than steel or cast iron. It can be welded to steel. It can be machined similar to steel. Although lead is somewhat soft, Mallory metal is hard. These characteristics make it much like very “heavy” steel. Although not chemically correct, this is an adequate “simple” description.

Now the question becomes, “Why do we want heavy steel?” Since we are racing, “heavy” doesn’t sound like something we would want to use other than for ballast. On the surface this is true. Looking at the general description of heavy metal, we might guess that we could use it to add weight to something in the same sense that we ballast the vehicle for better weight distribution. If this was your guess, you’d be pretty close. Mallory metal is used to add weight to the crankshaft.

The next question becomes, “Why would we want to add weight to a racing crankshaft?’ First, this is related to the fact that we typically race modified production engines. Most production engines since the early 1970s have used a cast iron crankshaft. Many of these cast iron crankshafts are externally balanced. The reason that these assemblies are externally balanced is that cast iron is slightly lighter than steel. Since the piston and connecting rod stay the same in any given engine assembly, any loss of weight from. the crank’s counterweights can cause the engine to be unbalanced. To fix this, production engineers add offset weights to the vibration damper and torque converter (or flywheel), making the engine externally balanced. In this case, “external” indicates outside of the short block assembly.

Having offset-weighted vibration dampers and torque converters (or flywheels) can be a problem in racing. Vibration dampers may have to be SFI approved for the class that you run. Torque converters are a commonly changed performance part. Flywheels can offer unique problems. Balancing the engine internally solves all of these problems. To accomplish this, we must add weight to the crankshaft in selected areas. Since the crankshaft is made of cast iron, the material we add must be heavier than cast iron—Mallory metal.

In NHRA and IHRA Stock and Super Stock classes, balancing is legal. It clearly states so in the rule book. NHRA technical people consider Mallory metal a 100% legal part of balancing. We (DaimlerChrysler/Mopar Performance Parts) have been doing this for many years.

Adding Mallory metal to the crankshaft sounds like we are going to increase its weight and inertia. Actually, the total weight stays the same. The weight that is added to the crankshaft is removed from the torque converter. If the problem was the damper (having to use an SFI approved damper), then the weight added would come off the damper. Total weight would remain basically the same. Crankshafts are balanced dynamically, or by spinning. This means that a balanced crankshaft has the same inertia (assuming we kept the same pistons, connecting rods, etc.). Actually, because Mallory metal is heavier than steel or cast iron and you add it near the outside diameter of the crankshaft where it has the maximum effect, the balanced assembly may be slightly lighter (in weight – at the same inertia).

To take this one step further, let’s look at actually lightening the crankshaft. One of the methods is called “knife-edging’’ the crankshaft. Generally, this process is NOT legal in Stock or Super Stock classes. It is legal in Modified/Competition classes, but read the rule book first for any given class. Knife-edging removes a lot of weight from the crankshaft; however, you can quite easily make the crankshaft too light. Mallory metal will again balance this knife-edged crankshaft. However, if found in a Stock or Super Stock engine, it will be illegal. The Mallory metal isn’t illegal, the knife-edging is!

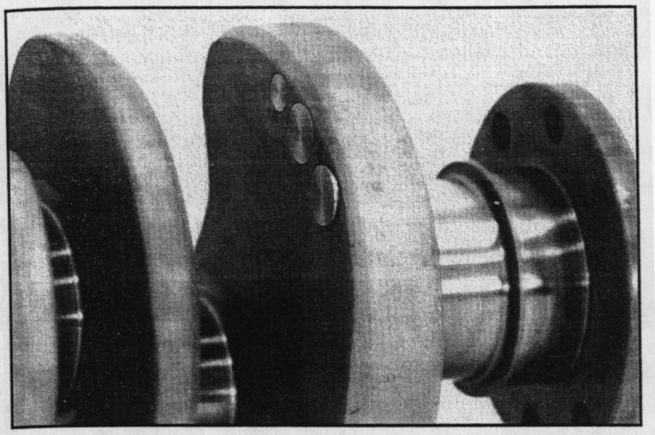

Figure 4 - 5

Tuff-Triding and Nitriding

Tuff-triding is a crankshaft surface treatment. It is a patented process that can only be done under license. It is also an older process which is not as popular with racers today as it once was. The popular surface hardening process today is generically called ***nitriding.*** There are several versions of it. While many people think that nitriding turns a crankshaft black, it may actually be gray. Therefore, color is not a good means of process identification. (Other types of metal treatments can result in similar colors.)

4.2L Engine Crankshaft Installation

If you are attempting to install a crankshaft from a 4.2L engine into a 4.0L engine, you may have to notch the bottom of the cylinder bores (as required) to obtain .100" clearance (Figure 4-4).

There are many variables associated with this popular modification (too numerous to go into detail here). For more information, call the Mopar Performance Parts Technical Assistance Hotline at 1-248-969-1690, or fax them at 1-248-969-3342. They'll be glad to help you.

MAIN JOURNALS

Crankshaft main journals should be checked for excessive wear, taper and scoring. Limits of taper or out-of-round on any crankshaft journal should be held to 0.013 mm (0.0005"). Journal grinding should not exceed *0.305* mm (0.012") under the standard journal diameter. DO NOT grind thrust faces of No. 3 main bearing journal. DO NOT nick crankshaft pin or bearing fillets. After grinding, remove rough edges from crankshaft oil holes and clean out all oil passages.

Caution: With nodular cast iron crankshafts it is important that the final paper or cloth polish after any journal regrind be in the same direction as normal rotation in the engine.

MAIN BEARINGS

Street Performance Bearings

These production style main bearings are made from AL6 aluminum. Package includes complete engine set. Standard size. For 4.0L engine only.

P4529207	Street performance bearings.

Main Bearing Material

Basically, there are three types of material used in main bearings: Babbit, aluminum and Tri-Metal. Babbit is considered a soft bearing material, while Tri-Metal is considered hard.

For all-out drag racing use, Babbit bearings are recommended. Babbit bearings should be checked regularly.

Maximum duty aluminum bearings are advisable for medium duty racing applications, and are actually preferred by some engine builders.

For constant high load, high rpm use such as in oval track racing, hard bearings made of F-77 Tri-Metal material are recommended. If Tri-Metal bearings are used with a cast crankshaft, they should be checked frequently and replaced regularly, even though they are hard, high load bearings.

High load, high rpm engines require maintenance. Pushing the bearing replacement cycle too far, or ignoring it, will usually cause an expensive failure. The cost doesn't justify the gamble.

Removal

1. Disconnect the battery negative cable.
2. Remove the spark plugs.
3. Raise the vehicle.
4. Remove the oil pan and oil pump as outlined in the 'Oiling System' section of this chapter.
5. If equipped, remove the main bearing cap brace (Figure 4-6).
6. Remove one main bearing cap and lower insert.
7. Remove the lower insert from the bearing cap.
8. Remove the upper insert by loosening (DO NOT remove) all of the other bearing caps and inserting a small cotter pin tool in the crankshaft journal oil hole. Bend the cotter pin as illustrated to fabricate the tool (Figure 2-13). With the cotter pin tool in place, rotate the crankshaft so that the upper bearing insert will rotate in the direction of its locking tab.

   Note: Because there is no hole in the No. 3 main journal, use a tongue depressor or similar soft-faced tool to remove the bearing insert. After moving the insert approximately 25 mm (1"), remove it by applying pressure under the tab.

9. Using the same procedure just described, remove the remaining bearing inserts (one at a time) for inspection.

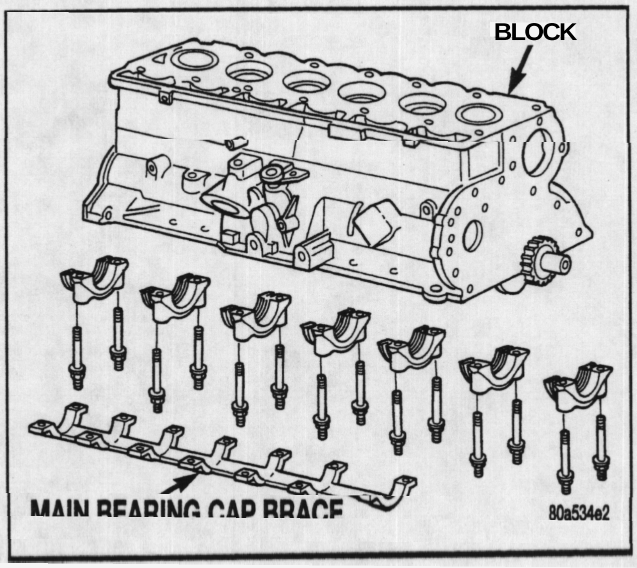

Figure ***4 - 6***

inspection

1. Wipe inserts clean and inspect for abnormal wear patterns and for metal or other foreign material imbedded in the lining. Normal main bearing insert wear patterns are shown in Figure 2-14.

   Note: If any of the crankshaft journals are scored, remove the engine for crankshaft repair.

2. Inspect the back of the inserts for fractures, scrapings, or irregular wear patterns.
3. Inspect the upper insert locking tabs for damage.
4. Replace all damaged or worn bearing inserts.

Fitting

(Refer to the *Main Bearing Fitting Chart* [Figure 4-91.)

The main bearing caps, numbered (front to rear) from 1 through 7 have an arrow to indicate the forward position. The upper main bearing inserts are grooved to provide oil channels while the lower inserts are smooth. Crankshaft end play is controlled by the thrust bearing which is flanged and installed at the No. 3 main bearing position.

Each bearing insert pair is selectively fit to its respective journal to obtain the specified operating clearance. In production, the select fit is obtained by using various sized, color-coded bearing insert pairs as listed in the *Main Bearing Fitting Chart* (Figure 4-9). The bearing color code appears on the edge of the insert. The size is not stamped on bearing inserts used for engine production.

The main bearing journal size (diameter) is identified in production by a color-coded paint mark (Figure 4-7) on the adjacent cheek toward the flanged (rear) end of the crankshaft, except for the rear main journal. The paint mark that identifies the rear main journal diameter is on the crankshaft rear flange.

Refer to *Main Bearing Fitting Chart* (Figure 4-9) to select the proper bearing inserts to obtain the specified bearing clearance. Refer to *4.0L Engine Specifications,* 'Engine Assembly' section, for the correct main bearing clearances.

When required, upper and lower bearing inserts of different sizes may be used as a pair. A standard size insert is sometimes used in combination with a 0.025 mm (0.001") undersize insert to reduce the clearance by 0.013 mm *(0.0005").*Never use a pair of bearing inserts with greater than a 0.025 mm (0.001") difference in size (Figure 4-8).

Note: When replacing inserts, install the odd size inserts either all on the top (in cylinder block) or all on the bottom (in main bearing cap).

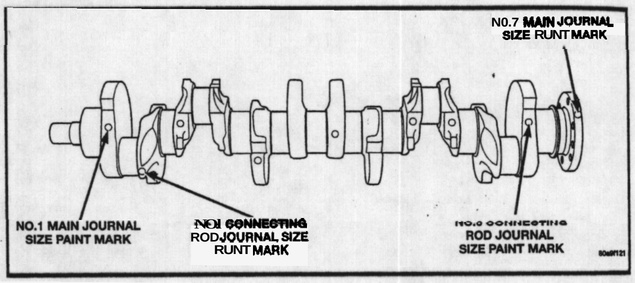
N0.7 MAIN JOURNAL SIZE RUNT MARK
NO.1 MAIN JOURNAL SIZE PAINT MARK
NO.1 CONNECTING ROD JOURNAL SIZE RUNT MARK
NO.6 CONNECTING ROD JOURNAL SIZE PAINT MARK
80a9f121

Figure ***4 - 7***

Insert	Correct	Incorrect
Upper	Standard	Standard
Lower	0.025 mm (0.001 in.) Undersize	0.051 mm (0.002 in.) Undersize

J9109-179

Figure 4 - 8

Installation

1. Lubricate the bearing surface of each insert with engine oil.
2. Loosen all the main bearing caps. Install the main bearing upper inserts.
3. Install the lower bearing inserts into the main bearing caps.
4. Install the main bearing caps and lower inserts.

Note: Rotate the crankshaft after tightening each main bearing cap to ensure the crankshaft rotates freely.

5. Tighten the bolts of caps 1, 2, 4, 5, 6, and 7 to 54 N•m (40 ft-lbs) torque, then tighten to 95 N•m (70 ft-lbs) torque. Finally, tighten the bolts to 108 N•m (80 ft-lbs) torque.
6. Push the crankshaft forward and backward. Load the crankshaft front or rear and tighten No. 3 cap bolts to 54 N•m (40 **ft-lbs)** torque, then tighten to 95 N•m (70 ft-lbs) torque. Finally, tighten the bolts to 108 N•m (80 ft-lbs) torque.
7. Check the crankshaft end play. Refer to *Crankshaft* ***End*** *Ploy,* later in this section.
8. If the crankshaft was removed, install the crankshaft into the cylinder block.
9. If equipped, install the main bearing cap brace and tighten the nuts to 47 N•m (36 ft-lbs) torque.
10. Install the oil pump assembly and tighten the attaching bolts to 23 N•m (17 ft-lbs) torque.
11. Install the oil pan with replacement gaskets and seals. Refer to the proper service manual for the procedure.
12. Tighten the drain plug securely.
13. Lower the vehicle.
14. Install the spark plugs. Tighten the plugs to 37 N•m (27 ft-lbs) torque.
15. Fill the oil pan with engine oil to the full mark on the dipstick level.
16. Connect the battery negative cable.

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4.0 LITRE

Main Bearing Fitting Chart

Crankshaft Journals #1 - #6		Corresponding Crankshaft Bearing Insert	
Color Code	Diameter	Upper Insert Size	Lower Insert Size
Yellow	63.5025-63.4898 mm (2.5001-2.4996 in.)	Yellow - Standard	Yellow - Standard
Orange	63.4898-63.4771 mm (2.4996-2.4991 in.) 0.0127 mm (0.0005 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Yellow - Standard
Blue	63.4771-63.4644 mm (2.4991-2.4986 in.) 0.0254 mm (0.001 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Green	63.4644-63.4517 mm (2.4986-2.4981 in.) 0.0381 mm (0.0015 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)
Red	63.2485-63.2358 mm (2.4901-2.4896 in.) 0.254 mm (0.010 in.) undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

Crankshaft Journals #7 Only		Corresponding Crankshaft Bearing Insert	
Color Code	Diameter	Upper Insert Size	Lower Insert Size
Yellow	63.4873-63.4746 mm (2.4995-2.4990 in.)	Yellow - Standard	Yellow - Standard
Oronge	63.4746-63.4619 mm (2.4990-2.4985 in.) 0.0127 mm (0.0005 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Yellow - Standard
Blue	63.4619-63.4492 mm (2.4985-2.4980 in.) 0.0254 mm (0.001 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Green	63.4492-63.4365 mm (2.4980-2.4975 in.) 0.0381 mm (0.0015 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)
Red	63.2333-63.2206 mm (2.4895-2.4890 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

J9409-29

Figure 4 - 9

Crankshaft End Play

Refer to Figure 2-18.

1. Attach a magnetic base dial indicator to the cylinder block at either the front or rear of the engine.
2. Position the dial indicator rod so that it is parallel to the centerline of the crankshaft.
3. Pry the crankshaft forward; position the dial indicator to zero.
4. Pry the crankshaft forward and backward. Note the dial indicator readings. End play is the difference between the high and low measurements. Correct end play is 0.038-0.165 mm (0.0015-0.0065"). The desired specifications are 0.051-0.064 mm (0.002-0.0025").
5. If end play is not within specification, inspect crankshaft thrust faces for wear. If no wear is apparent, replace the thrust bearing and measure end play. If end play **is** still not within specification, replace the crankshaft.

REAR MAIN OIL SEAL

The crankshaft rear main bearing oil seal consists of two half pieces of neoprene with a single lip that effectively seals the rear of the crankshaft (Figure 4-10). Replace the upper and lower seal halves as a unit to ensure leak-free operation.

Removal

To replace the rear main oil seal, the transmission must be removed. Refer to the service manual for the procedure.

1. Remove the flywheel or torque converter drive plate.
2. Remove the oil pan. Refer to the proper service manual for the procedure.
3. Remove the rear main bearing cap (No. 7).
4. Push the upper seal out of the groove. Ensure that the crankshaft is not damaged.
5. Remove the lower half of the seal from the bearing cap.

Installation

1. Wipe the seal surface area of the crankshaft until clean.
2. Apply a thin coat of engine oil.
3. Coat the lip of the seal with engine oil.
4. Position the upper seal into the groove in the cylinder block. The lip of the seal faces toward the front of the engine.
5. Place the lower half of the seal into the bearing cap (Figure 4-10).
6. Coat both sides of the lower seal end tabs with Mopar Gasket-in-a-Tube, or equivalent. DO NOT apply sealant to the lip of the seal.
7. Coat the outer curved surface of the lower seal with soap and the lip of the seal with engine oil.
8. Position the lower seal into the bearing cap recess **and** seat it firmly.
9. Coat both chamfered edges of the rear main bearing cap with Mopar Gasket-in-a-Tube, or equivalent.

   Caution: DO NOT apply sealant to the cylinder block mating surfaces of the rear main bearing cap because the bearing-to-journal clearance would be altered.
10. Install the rear main bearing cap.
11. Torque all main bearing bolts to 108 N•m (80 ft-lbs).

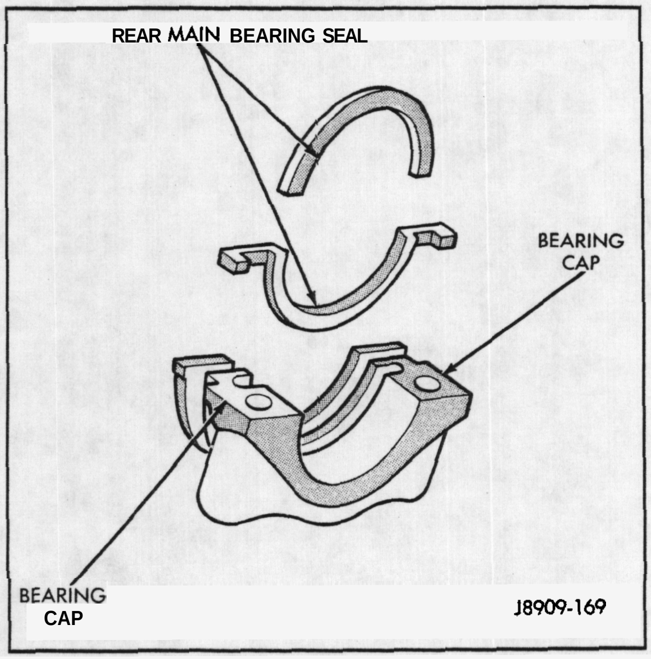

Figure 4 - 10

VIBRATION DAMPER

The reason for a vibration damper on an engine is to dampen the frequencies and/or harmonics that are created when the engine runs (rotates). In simplified terms, to "dampen" means to *soften* or *decrease the effect*. This keeps the crankshaft from breaking, helps it last longer, and helps bearing durability. In some engines you could even fail blocks because of excessive vibration. That's why a solid hub damper (or no damper at all) breaks the crankshaft quicker. This durability effect is greater in an oval track racing vehicle than a drag racing vehicle, and greater in a bracket racer than a Super Stocker (for example).

In the past, we've discussed the weight factor in rubber dampers. To summarize, the heavier the damper ring, the more effective the damper is. Therefore, on oval track vehicles, Chrysler-Plymouth-Dodge used a much larger damper to maintain durability.

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Currently, the NHRA requires an SFI approved vibration damper as mandatory equipment in Comp Eliminator, Super Stock, Super Comp, Super Gas, and Super Street. They are also permitted in Stock Eliminators. Since January 1991, these SFI dampers have been mandatory on all E.T. bracket vehicles that run 10.99 and quicker. If you run a fast vehicle, you should be aware of these special dampers.

There are basically three vibration damper approaches that can be used. You can use a solid hub damper, a fluid/viscous damper, or a rubber-style damper. DO NOT USE A SOLID HUB DAMPER. It breaks crankshafts. This leaves the comparison between rubber and viscous dampers. Realize that production (stock) dampers work fine in stock condition, but they are not legal in fast vehicles; i.e., they are not SFI approved. Now the question becomes which one to use?

The first consideration is cost. Rubber dampers tend to be less expensive. However, this is like selecting a cast iron intake manifold over an aluminum one because the cast iron manifold costs less. There's more to it than that.

The second consideration is inertia. This translates into a damper's rotational weight. Without getting into fancy terms with a rubber damper, everything has to rotate with the crankshaft and at the same speed (rpm) as the crankshaft. This isn't true of a fluid/viscous damper. A large part of the viscous damper's weight doesn't follow the engine's rpm exactly. It works something like a viscous fan. This can be a big advantage in a drag engine or short track engine where engine speeds change quickly and by large amounts.

One of the characteristics of a rubber damper is that it has to be tuned to a selected rpm band of operation. This means that, for any given engine package, the damper is tuned to a specific rpm. The viscous damper does a better job at a wide range of frequencies (rpms). This again is a big advantage for the racer who races under many different conditions, rpms, track lengths, etc.

The only real "problem" with rubber dampers is that the rubber can deteriorate. This can manifest itself in the outer ring slipping. This causes the timing mark to move. At this point the damper should be replaced.

In summary, we recommend that a steel ring (SFI approved) vibration damper be used for general high performance (dual purpose) vehicles, and a viscous/fluid vibration damper be used for race-only drag, oval track, or endurance vehicles.

Damper Attachment Package

Attaching bolt package necessary to attach damper to crankshaft.

P4529677	Damper attachment package.

Vibration Damper Failure

Basically, vibration dampers keep the crankshaft from breaking. Longer stroke crankshafts work the vibration damper harder. So do higher rpm and more output to a lesser degree. Lighter dampers don't do as good a job as heavy dampers. Racing engines today are getting larger with longer strokes. We need the best damper we can get to keep the crankshaft from breaking. Without extensive testing, the best rule is the heavier the better. The production weight damper is another good guideline since there has been more testing on it than any other.

Most crankshaft failures are the result, not the cause. The damper causes the crankshaft to fail, not the other way around. If a crankshaft fails, always look to'oiling first, then the damper. You can't blame an oiling failure on the damper. But you also have to select the damper that allows the crankshaft to work. If you take weight out of the damper and the crankshaft fails, you know you went too far!

Vibration Damper Performance Tips

We have covered the advantages of a good race vibration damper. Like any race piece, there are always little problems that crop up as you get into actual racing, such as notching pistons for a big camshaft and matching ports on the intake manifold. Vibration dampers are no exception.

First of all, always double check the timing mark. Double check it against actual top dead center (TDC). This tip really has nothing to do with the damper itself. We (DaimlerChrysler) have told racers over and over again to check the timing marks on their dampers. Check, check, and recheck! You should never switch dampers without checking the timing mark. Remark your damper as required. (Refer to ***Top Dead Center*** *(TDC),* in this section, for complete information.)

Another tip concerns pulley spacing. Proper spacing has been a problem on every high rpm engine built. Aluminum pulleys add to the complexity of the problem. There is no easy solution. Aligning the various pulleys so that all the belts run true takes a little bit of patience and some measuring, but it must be done.

Removal

1. Remove the drive belt(s).
2. Remove the retaining bolts and separate the vibration damper pulley (V-belt ONLY) from the vibration damper.
3. Remove the vibration damper retaining bolt and washer.
4. Use a vibration damper removal tool to remove the damper from the crankshaft (Figure 2-2).

BARBARY COAST
604
Walker Evans Racing
Scott Douglas
Mopar PERFORMANCE
604
CRAFTSMAN
GOODYEAR
MSD
TRUCK GUARD

Installation

1. With the key in position, align the key slot of the vibration damper hub with the crankshaft key and tap the damper onto the crankshaft.
2. Install the vibration damper retaining bolt and washer. Tighten the bolt to 108 N•m (80 ft-lbs) torque. If the crankshaft turns before the damper bolt torque value is attained, the crankshaft can be prevented from turning by placing two 5/16" x 1-1/2" bolts into the damper front pulley' holes and wedging a bar between them. Rotate the bar until it contacts the frame member to prevent the crankshaft from turning.
3. Install the damper pulley (V-belt only) and retaining bolts. Tighten the bolts to 27 Nom (20 ft-lbs) torque.
4. Install the drive belts(s) and tighten to the specified tension. Refer to the service manual for the proper specifications and procedures.

TIMING CHAIN AND SPROCKETS

Installation of the timing chain with the timing marks on the crankshaft and camshaft sprockets properly aligned ensures correct valve timing. A worn or stretched timing chain will adversely affect valve timing. If the timing chain deflects more than 12.7 mm (1/2"), replace it. The correct timing chain has 48 pins. A chain with more than 48 pins will cause excessive slack. For removal and replacement procedures, refer to the proper service manual.

Jeep Gear Drives

Replace conventional Jeep timing chain and gear sets and eliminate chain induced cam timing fluctuations with this Mopar Performance Parts dual idler gear drive camshaft centerlining drive system. Rugged and durable for off-road applications. Fits all 4.0L, 4.2L, and 2.5L Jeep engines.

P5249009	Jeep gear drives.

All-Out Race Chain and Sprockets

Cloyes matched sprockets and double roller chain for all-out race applications. Has three matched keyways to adjust cam timing. Kit includes Magna-fluxed sprockets and roller timing chain. For 2.5L and 4.0L engines only.

P5249519	All-out race chain and sprockets.

Installation Tips

1. Be extremely careful to apply full torque to the camshaft sprocket attaching bolts. It is also advisable to apply Loctite. If these precautions aren't taken, engine torsional vibration may cause the camshaft bolts to loosen and the camshaft will turn. If the bolts loosen, the locating dowel will shear off because it is not intended as a load carrying member. As an extra added measure, use at least Grade 8 bolts.
2. The bushings in the timing chain rollers will deteriorate with hard usage. Change the timing chain when it becomes stiff and the links DO NOT move freely, as this indicates bushing breakage.

   Also, replace camshaft and/or crankshaft sprockets if there is any evidence of teeth being bent through dropping or other mishandling. Bent teeth may break off causing the chain to break.

   Note: When installing a new camshaft or reassembling the engine after an overhaul, coat the camshaft lobes and tappets liberally with Mopar Engine Oil Supplement (or equivalent). This aids camshaft and tappet break-in and helps prevent scuffing.

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